Cirriculum Vita - Robert E. Ecke

Laboratory Fellow, Condensed Matter and Thermal Physics Group and Center for Nonlinear Studies, Group MST-10, MS-K764, Los Alamos, NM 87545; phone: (505) 667-6733, -4133, -4566 (lab)

Experimental condensed matter physicist specializing in nonlinear dynamics and chaos, hydrodynamic instabilities, pattern formation, and turbulence.

Education

B.S. Physics, University of Washington, with Distinction in Physics, Cum Laude, Phi Beta Kappa, 1975.

Ph.D. Physics, University of Washington, 1982
Thesis: *Monolayer Solid Helium and its Melting Transition*
Advisor: Professor J.G. Dash

Awards and Honors

Los Alamos National Laboratory Fellows Prize for Outstanding Scientific Research, 1991.
Fellow of the American Physical Society, 1994.

Research and Administrative Experience

1978-1982:	Research Assistant, University of Washington. Experimental low temperature physics, phase transitions, surface physics, and critical phenomena.
1982-1983:	Postdoctoral Research Associate, University of Washington. Ultralow temperature techniques, SQUID operation, critical phenomena.
1983-1986:	Director's Funded Postdoctoral Fellow, Los Alamos National Laboratory. Nonlinear dynamics, superfluid helium, superfluid turbulence.
1991-1993:	Acting Deputy Director, Center for Nonlinear Studies.
1986-Present:	Staff Member, Condensed Matter and Thermal Physics Group, Los Alamos National Laboratory. Hydrodynamic instability, pattern formation, fluid dynamics, turbulence, low temperature physics, superfluid helium.
1987-Present:	Research Affiliate, Center for Nonlinear Studies, Los Alamos National Lab.
1997-Present:	Laboratory Fellow, Los Alamos National Laboratory.

Notable Research Accomplishments

- **^{3}He-superfluid-^{4}He mixture convection:** Critical slowing down near Hopf bifurcation, $\epsilon^{n/2}$ scaling of nth harmonic amplitude, superfluid turbulence in convection.
- **Nonlinear dynamical systems:** Quasiperiodicity and mode-locking, fractal dimension and Kolmogorov entropy, transition to chaos via intermittency and effects of noise on transition, bifurcation theory of 2D maps, basins of attraction for chaotic and quasiperiodic states.
- **Quasiperiodic transition to chaos:** Fat-fractal scaling of mode-locked tongues, Feigenbaum dynamical scaling function and corresponding f(α) analysis for experimental data, transient Poincaré sections and internal structure of mode-locked tongues.
- **Rotating convection wall mode:** Traveling-wave wall mode in rotating Rayleigh Bénard convection, correspondence with complex Ginzburg-Landau equation, phase diffusion.

- **Vortex structures in rotating convection:** Thermal vortex structures in rotating convection, simultaneous flow visualization and heat transport over large range of Rayleigh and Taylor number.
- **Low-Prandtl number convection:** Low-Prandtl number gas convection, transition to spiral-defect chaos, radiation of sidewall foci, new wave number selection mechanism, scaling properties of axisymmetric patterns, motions of defects, chiral-symmetry breaking of spirals under rotation in gas convection.
- **Küppers-Lortz transition in rotating convection:** Heat transport and flow visualization near onset of Küppers-Lortz transition in rotating convection, test of linear stability analysis at high rotation (water) and for low rotation (CO_2 gas), length and time scalings of pattern dynamics.
- **Turbulent convection** 2/7 power law scaling of heat transport,boundary layer profiles and probability distributions for rotating thermal convection, Prandtl number dependence of 2/7 scaling in non-rotating convection, structure of thermal vortices using thermochromic liquid crystal and particle image velocimetry techniques, instability of thermal boundary layer during spin up.
- **Turbulent mass dissolution:** Pattern-forming instability in turbulent mass dissolution, mass transport scaling and linear growth of surface pattern.
- **Soap Film Flows:** Velocity, vorticity and thickness measurements of flowing soap films, correlations between vorticity and thickness.

Highlight Publications

1. H. Haucke and R.E. Ecke, "*Mode-Locking and Chaos in Rayleigh-Bénard Convection*," Physica D **25**, 307 (1987).

2. R. Mainieri, T.S. Sullivan, and R.E. Ecke, "*Two-Parameter Study of the Quasiperiodic Route to Chaos in Convecting ^{3}He-Superfluid-^{4}He Mixtures*," Phys. Rev. Lett. **63**, 2357 (1989).

3. F. Zhong, R.E. Ecke, and V. Steinberg, "*Rotating Rayleigh-Bénard Convection: Asymmetric Modes and Vortex Structures*," J. Fluid Mech. **249**, 135 (1993).

4. R. Mainieri and R.E. Ecke, "*Dynamical Scaling Function at the Quasiperiodic Transition to Chaos*," Physica **D79** 193 (1994).

5. Y. Hu, R.E. Ecke, and G. Ahlers, "*Transition to Spiral Defect Chaos in Low Prandtl Number Convection*," Phys. Rev. Lett. **74**, 391 (1995).

6. Y. Hu, R.E. Ecke, and G. Ahlers, "*Time and Length Scales in Rotating Rayleigh-Bénard Convection*," Phys. Rev. Lett. **74**, 5040 (1995).

7. R.E. Ecke, Y. Hu, R. Mainieri, and G. Ahlers, "*Excitation of Spirals and Chiral Symmetry Breaking in Rayleigh-Bénard Convection*," Science **269**, 1704 (1995).

8. Y. Liu, L. Ning, and R.E. Ecke "*Dynamics of Surface Patterning in Salt Crystal Dissolution*," Phys. Rev. E **53**, R5572 (1996).

9. Y. Liu and R.E. Ecke, "*Eckhaus-Benjamin-Feir Instability in Rotating Convection*," Phys. Rev. Lett. **78**, 4391 (1997).

10. Y. Liu and R.E. Ecke, "*Heat Transport in Turbulent Convection: Effects of Rotation and Prandtl Number* ," Phys. Rev. Lett. **79**, 2257 (1997).